ARGONNE NATIONAL LABORATORY

IDAHO DIVISION

REPORT OF EBR-II OPERATIONS

October 1, 1967 through December 31, 1967

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IDAHO FALLS, IDAHO

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I. Operations

A. Summary

The last two parts of Run 26, which were designated Runs 26B and 26C, were completed during this quarter. Run 26B covered the period from October 11 through 20 and comprised 1029 MWd(t) of operation; Run 26C covered the period from November 22 through December 12 and comprised 619 MWd(t).

At the beginning of the quarter, the primary tank had been cooled down to 600°F for the installation of the rotary oscillator rod and drive mechanism. Control-rod drive assembly No. 7 was first removed because the gripper jaws had been sticking, and the control-rod drive from position No. 8 was moved to the No. 7 position. Following this, the rotary oscillator drive was installed in the No. 8 position. Concurrently with these operations, the loop to the Fuel Element Rupture Detector (FERD) was secured for installation of a new primary-sodium plugging valve and a sodium sampling station. An operational checkout of the rotary oscillator drive was made after returning the primary system to 700°F.

Experimental subassemblies X025, X026, and X030 were installed, and the reactor was taken critical to measure the excess reactivity. Run 26B was scheduled for approximately 1050 MWd of operation. The reactivity measurements revealed that additional core changes would be required for reactivity adjustments to achieve the intended run length. Following these changes, the reactor was restarted, and the control rods and the oscillator rod were calibrated. Low-power oscillator experiments were performed, and the rotary oscillator performed satisfactorily through its frequency range. Power coefficient measurements were made after each 5-MW power increase up to 45 MWt. At each 5-MW increment, the torque required to manually rotate the oscillator rod was measured and recorded. At 30 MW the torque increased, indicating possible bowing and rubbing of the oscillator rod; therefore, oscillator experiments were temporarily discontinued above 35 MW.

Rod drop tests and further oscillator experiments (at frequencies from 0.0025 to 8.8 Hz) were conducted at 500 kW and 22.5 MW. Subsequent oscillator experiments at 30 and 41.5 MWt were performed only from maximum frequency to 0.1 and 0.3 Hz, respectively, because of rod rubbing below these values.

Reduced-flow experiments at 22.5 MW with 90, 75, 60, and 54% flow were conducted. Between physics program experiments, reactor operation at 45 MW continued. From October 27 through November 5 the reactor power level was kept at 45 MW.

During this period, the FERD loop was returned to normal operation, and operational checkout of the new plugging meter and sodium sampling station was carried out.

A. Summary (continued)

On November 6, additional reduced-flow and reduced-power experimental data were obtained, followed by further oscillator experiments at 22.5 and 30 MW. After a critical position measurement was obtained at 50 kW on November 8, a high lubricating-oil temperature in the motor-driven feedwater pump was noted. The reactor and the pump were shut down. Inspection of the pump revealed that the inner thrust bearing had worn out. The reactor was restarted, and power was raised to 15 MW while using the startup feedwater pump and to 20 MW while using the turbine-driven feedwater pump.

The power coefficient between 15 and 20 MW appeared to approach zero, but the reactivity change observed was about equal to the uncertainty of measurement. After power had been lowered to 15 MW for obtaining additional data, the reactor was shut down, and maintenance was performed while the power coefficient situation was reviewed. The repair of the motor-driven feedwater pump and the annual leak-rate test of the emergency airlock in the reactor building were carried out. Bi-weekly, monthly, and quarterly interlock checks were completed, and the periodic test of emergency power system and bus tie circuit breakers was made.

Following consultation within ANL Lemont and agreement on a plan of action with the AEC, the reactor was restarted on November 12 for continuation of power coefficient measurements. These were interrupted when, shortly after the power reached 20 MW, the primary system bulk-sodium temperature began increasing, and the reactor was shut down. It was found that because of malfunction of the steam drum water-level recorder-controller (and alarm) the drum had been boiled dry, and most of the water in the evaporators had been lost. The secondary sodium level in the surge tank was lowered to stop natural convection and conserve the remaining water in the steam system. Cooldown of the primary tank was begun. After the sodium lines evaporators, superheaters, and steam drum had cooled sufficiently, feedwater at 350°F was slowly added to reestablish normal water level in the steam drum.

Cooldown of the primary tank continued until the bulk sodium temperature approached 450°F. Secondary sodium temperatures were simultaneously raised from 350° and 420°F. Sodium level in the surge tank was then raised very slowly toward the operating level and minimum flow in the forward direction was established. Finally, the secondary sodium flow was gradually increased until normal plant heatup conditions were attained and the primary sodium system temperature raised to 600°F by means of electrical heating. Nuclear heat was used to raise the bulk sodium from 600° to 700°F.

During the heatup of the primary tank from 600° to 700°F, the isothermal temperature coefficient was measured and found to be 1.08 Ih/°F which is slightly higher than the previously measured value of 1.04 Ih/°F during Run 25.

At 700°F control rod No. 5 was period calibrated again in preparation for coefficient measurements. The reactor was raised in 5 MW steps to

A. Summary (continued)

45 MW, and the point differential power coefficient was found to be negative throughout the range, with a value of 38.2 Ih measured for the overall power-reactivity decrement. Following an interval of 45 MW operation, additional oscillator experiments were run at 20 MW and 30 MW. The reactor power was then reduced incrementally to measure the power-reactivity decrement and Run 26B was terminated.

Following melting of the rotating plug seal troughs to prepare for loading changes, some difficulties were encountered in rotating the large seal plug. Probing through the inspection hole revealed several islands of accumulated dross in the seal troughs and cleaning operations using the brush technique were instituted. Following the cleaning, 200 lb of CEROTRU alloy were added to reestablish normal level in the trough.

Reactor loading changes included the addition of four experimental subassemblies - - X027, X028, X031, and X032. The control circuit used in rod-drop experiments was transferred from control rod No. 1 (a stainless steel control rod) to standard control rod No. 5. This change was instituted in an effort to get a larger reactivity step change in rod-drop experiments.

Run 26C began on November 22 and was scheduled for 620 MWd. Control rods were calibrated prior to obtaining power-coefficient and oscillator-torque measurements. During the increase in power from 20 to 25 MW on November 23, the Fission Gas Monitor (FGM) indicated a small fission gas release. Cover gas samples confirmed that a fission gas release of small magnitude had occurred, and the reactor was shut down for evaluation of the data. A plan was developed for restarting the reactor and incrementally raising power at one-hour intervals until a gas release occurred in an attempt to identify the leaker. At 25 MWt a second gas release of much smaller magnitude than the first was observed. Maintaining power at that level for 8 hours produced no other detectable release, and the FGM returned to approximately a normal background level. Gamma spectrum analysis data from the primary-tank gas samples indicated probable failure of a driver fuel element which had only recently been inserted; therefore, one of them was suspected. Two driver subassemblies had been placed in the core just prior to startup. Following reactor shutdown, both were replaced and transferred to the Fuel Cycle Facility for subsequent examination.

After reactor startup, power was again raised in 5 MW increments with gas-sample radiometric analysis, power-coefficient measurements, and oscillator-torque measurements being taken at each level. Rubbing of the oscillator was again noted at 30 MW, and torque measurements were terminated at 35 MW. No further abnormal fission-gas signals appeared as operation continued at 45 MW. Reduced-flow experiments were performed again at 41.5 MW and 22.5 MW. On November 30, during measurement of the power coefficient at 15 MW, the operating limit of 0.5 Ih/MW was approached. The reactor power

A. Summary (continued)

was reduced, the control rods were rebanked, and the decrement was measured again. The results of the second measurement agreed substantially with the first. The power was then increased to 45 MW without exceeding the operating limit for the power coefficient. After all systems were allowed to stabilize at power, the power-reactivity decrement agreed basically with previous Run 26 measurements.

During further Run 26C operations, rod-drop experiments were performed from 45 MW using control rod No. 5 to obtain 50 Ih rod-drop increments. The rod was dropped from 5.58 in. to achieve the desired negative reactivity step. About 15 sec after the drop, reactor power fell to about 15 MW, and the rod was then raised to restore full reactor power. The use of standard control rod No. 5 for this type of test proved to be unsatisfactory because of the longer drop time than was obtained with the stainless steel rod. The greater effect of dashpot action on the short travel distance at the end of the stroke was the reason for the longer drop time.

Operation at 45 MW continued until December 10, when additional reduced-flow experiments were carried out at power levels from 41.5 MW to 15 MW. The new plugging meter in the FERD loop was placed in routine operation. During this period, FGM readings were normal; however, the grab samples taken from the primary tank cover gas showed a slow but steady increase in the xenon-133 and -135 activity. On December 6 the xenon-135 had reached its equilibrium value and the xenon-133 was approaching its equilibrium value. At approximately 1800 hours, both these activities began a slow and continual increase, and by December 11, the xenon-135 appeared to reach a new equilibrium value. Observations during the period from December 7 through December 10 have been interpreted as indication of a fission gas release. Since there were no indications of any significant increase in the FGM or FERD signals at any time during this period, it was difficult to be certain that the results of gas analyses indicated an actual fission product release. Radiochemical analyses of the primary-tank sodium samples revealed no discernible increase in the content of cesium-137. While the normal level of iodine-131 had not been measured, iodine-131 in the sodium was found to be present by a factor of 40 greater than the value calculated to be present from tramp uranium in the reactor. The reactor was shut down pending further analysis.

During the shutdown to evaluate the fission gas activity data, the rotating plug seal troughs for the large and small plugs were thoroughly cleaned by use of a metal brush technique. Following this cleaning, 200 lb and 68 lb respectively of CEROTRU were added to the large and small troughs to restore the alloy level. On December 19 the control rods were again intercalibrated at a 14 in. rod-bank position, and Run 26C was terminated. Control rod drive No. 6 required removal because of malfunctioning gripper jaws and was replaced with a spare drive.

A. Summary (continued)

The reactor loading changes for Run 27 involved replacement of 28 subassemblies and included the installation of driver subassemblies and two experimental subassemblies, X029 and X033.

During the removal of control rod subassembly L-446 from the No. 12 position (5C3), interference was encountered at the 52 in. and 69 in. elevations. This subassembly was placed in the storage basket for decay cooling prior to shipment to the FCF for examination. The slip clutch in the drive mechanism of the core holddown upper assembly became inoperative, and the force limit device apparently malfunctioned during attempted installation of a new control rod; fuel handling operations were therefore discontinued until a complete overhaul of the holddown upper assembly and force limit mechanism could be completed.

B. Chronology of Principal Events

DATE	EVENT
10-1-67	Plant status: Run 26A completed. Maintenance shutdown in progress. Plant in 600°F standby condition to prepare for installation of new oscillator rod and rotary drive mechanism.
10-2-67	Control rod No. 7 drive-shaft assembly removed from its position in the reactor because of operational difficulties with the jaw drive mechanism.
10-3-67	Control rod No. 8 drive-shaft assembly removed from the primary tank in preparation for the installation of the rotary oscillator mechanism. No. 8 control rod drive-shaft assembly placed in the No. 7 position.
10-4-67	Oscillator rod installed in the reactor core. FERD loop secured for installation of a primary sodium plugging valve and sodium sampling station.
10-5-67	Completed installation of the oscillator drive shaft and started heat-up of the primary system to 700°F. Experimental subassembly X027 removed from storage basket and sent to FCF.
	Flow to secondary sodium purification cold trap bypassed; plugging temperature now < 225°F.
10-7-67	Primary system at 700°F standby. Shut down primary sodium purification system because of a small leak through the "P1-A" plugging-loop throttle-valve seat.
10-9-67	Replaced the throttle valve on the P1-A plugging loop in the primary purification system. System returned to normal operation. Operational checkout of the oscillator rod drive in progress.
10-10-67	Started heating FERD loop prior to sodium filling.
10-11-67	FERD loop filled and placed in normal operation. Operational checkout of rotary oscillator rod drive completed.
	Removed stainless steel (dummy) subassembly X000 and replaced it with experimental subassembly X025. Four inner blanket subassemblies replaced including the installation of experimental subassemblies X026 and X027. Reactor taken critical to determine reactivity to start Run 26B.
	Reactor shut down for a reactivity adjustment (increase).

B. Chronology of Principal Events (continued)

DATE	EVENT
10-12-67	Removed half-worth subassembly C-2003 from core position 4B3 and replaced it with driver subassembly C-2064. Reactor taken critical for reactivity determination. Reactor shut down for a reactivity adjustment (decrease). Removed inner blanket driver subassembly B-356 from core position 6C1 and replaced with half-worth subassembly B-3000. Removed "J-2" instrument thimble from primary tank. Replaced a defective preamplifier on log count rate channel No. 3.
10-13-67	Reactor critical for reactivity determination and control rod calibration.
10-14-67	Increased reactor power incrementally to 45 MWt for power coefficient measurements.
10-15-67	Reduced reactor power to 500 kW. Oscillator experiments in progress.
10-16-67	Oscillator experiments in progress at 22.5 MWt. Upon completion of physics program for the day, increased reactor power to 45 MWt.
10-17-67	Reduced reactor power to 30 MWt for oscillator experiments.
10-18-67	Transferred experimental subassembly X900 containing pressure-stressed 304-L tubes from the storage basket to FCF.
10-19-67	Reduced flow experiment conducted with reactor power at 22.5 MWt and 30 MWt. Upon completion, increased reactor power to 45 MWt.
10-23-67	Oscillator experiments performed at 22.5 MWt, 30 MWt and 45 MWt. Transferred X900 from FCF to the primary tank storage basket. Reactor-building bridge crane taken out of service for replacement of a bearing in the bridge wheel.
10-24-67	Started operational checkout of the new FERD sodium sampling station and plugging meter.
10-26-67	No. 1 shield cooling exhaust fan out of service for maintenance of the outlet damper.

B. Chronology of Principal Events (continued)

DATE	EVENT
10-27-67	The thrust bearing was replaced on the turbine-driven condensate pump. A thermocouple was installed in each turbine bearing thermowell with a readout instrument provided on the pressure gauge panel. No. 1 shield cooling exhaust fan placed in normal operation. Reduced reactor power to 500 kWt for oscillator experiments.
10-28-67	Run No. 26B continued at 45 MWt and 15 MWe.
10-29-67	Reactor-building crane returned to service.
10-31-67	Annual leak-rate test of reactor-building electrical penetrations in progress.
11-2-67	Generator separated from the NRTS loop 9 hours. EBR-II load carried by the generator. Completed leak-rate test of electrical penetrations.
11-3-67	Performed annual leak-rate test on the reactor-building automatic vacuum-break valve. Shut down the FERD loop sample station and plugging meter because of an indicated leak in the system.
11-6-67	Subassembly X900 transferred from the primary tank storage basket to the FCF. Reduced reactor power for reduced-flow tests.
11-7-67	Completed low-flow tests and returned reactor power to 45 MWt. Reduced reactor power to 22.5 MWt for oscillator tests. Performed oscillator test and returned reactor power to 45 MWt.
11-8-67	Reduced reactor power for oscillator tests, and upon completion lowered reactor power to 50 kWt for a 4-hour period. While increasing reactor power, the thrust bearing of the motor-driven feedwater pump failed. Reduced reactor power to 50 kWt.
11-9-67	Reactor shut down to evaluate condition of motor-driven feedwater pump. Reactor taken critical to period-calibrate control rod No. 5. Reactor shut down. Plant in standby condition, while power coefficient was reviewed.
11-10-67	Performed biweekly, monthly, and quarterly interlock checks. Completed leak-rate test on emergency airlock doors.

B. Chronology of Principal Events (continued)

DATE	EVENT
11-11-67	Conducted "Periodic Test of Emergency Power System and Bus Tie Circuit Breakers" and procedure Outage of 480-volt normal power for replacement of Laboratory & Office Building Feeder Breaker. Reactor taken critical for power coefficient measurements.
11-12-67	Completed repairs on the motor-driven feedwater pump. While taking power coefficient data at 20 MWt, the steam drum level recorder-controller and alarm failed, causing the steam drum to be boiled dry with subsequent loss of water level in the evaporators. To conserve remaining water in the evaporators, the reactor was immediately shut down and the secondary sodium system partially dumped to stop natural convection. Cooldown of the primary tank was initiated in preparation for filling the evaporators and steam drum.
11-13-67	Sodium lines, evaporators, superheaters, and steam drum cooled for feedwater addition. Started slowly adding 350°F feedwater through the evaporators to the steam drum.
11-14-67	Completed filling the steam drum to a normal level. Continuing cooldown of the primary tank to 450°.
11-15-67	Completed a very slow filling of the secondary sodium system, after which a minimum sodium flow in the forward direction was established. Began normal plant heat up to plant standby condition.
11-17-67	Reactor taken critical, control rod No. 5 calibrated. Power increased to 3 MWt to heat the primary-tank bulk sodium from 600°F to 700°F and determine isothermal temperature coefficient from 600°F to 700°F (1.08 Ih/°F). Primary-tank bulk sodium at 700°F.
11-18-67	Period calibrated control rod No. 5 prior to taking power coefficient measurements. Power coefficient measurements taken from 10 MWt to 45 MWt in 5 MWt increments.
11-19-67	Reduced reactor power to 20 MWt for torque measurements on the oscillator rod. Performed oscillator experiments with reactor power at 41.5 MWt and 30 MWt. After completing the experiments, increased reactor power to 45 MWt.
11-20-67	Run 26B complete after 1115 MWd of accumulated reactor operation. Started brush cleaning the large plug rotating seal trough through 360°. Transferred the control circuit from control rod No. 1 (stainless steel rod) to control rod No. 5 (standard control rod).

B. Chronology of Principal Events (continued)

DATE	EVENT
11-21-67	Completed brush cleaning the large plug rotating seal trough and added 200 pounds of alloy to re-establish a normal level in the trough.
11-22-67	Exchanged seven subassemblies including the installation of experimental subassemblies X027, X028, X031 and X032. Relocated experimental subassemblies X015 and X016, completing scheduled grid changes. Reactor taken critical for control rod calibration and start of Run 26C.
11-23-67	Increased reactor power in 5 MWt increments for power-coefficient and oscillator-rod-torque measurements. During an increase in power from 20 MWt to 25 MWt, a small fission gas release was indicated by the Fission Gas Monitor (FGM). Cover gas samples confirmed that a fission gas release had occurred. The reactor was shut down and the building evacuated, though no high air activity was indicated. Entrance to the reactor building was limited to authorized personnel as a precaution until a survey of the building had been completed.
11-24-67	The reactor was taken critical and the power level raised in 5 MWt steps to 25 MWt, holding at each power level for a period of one hour. A cover gas sample was taken at the end of each hour period. After reaching 25 MWt, the FGM again indicated a small fission gas release and a sample of the cover gas confirmed the release. Reactor shut down to remove two driver subassemblies placed in the core prior to Run 26C.
11-25-67	Replaced subassembly C-2111 with subassembly C-2041 in core position 1A1 and subassembly C-2113 with subassembly C-2042 in core position 4A3. Completed operational check-out of the Fission Gas Monitor (FGM) and the Fuel Element Rupture Detection (FERD) loop. Started the reactor and increased power to 5 MWt to obtain an FGM signal to be used as a reference in determining if the defective subassembly had been removed.
11-26-67	Increased reactor power in 5 MWt steps to 45 MWt. Monitored all subassembly outlet temperatures, analyzed gas samples and torqued the oscillator rod at each power level. Reactor at 45 MWt. No evidence of a fission gas release.
11-28-67	The "P1-A" economizer heater failed in the plugging loop of the primary sodium purification system, putting the plugging loop out of service.

B. Chronology of Principal Events (continued)

DATE	EVENT
11-29-67	Performed reduced-flow experiments with reactor power at 41.5 MWt and 22.5 MWt. Returned reactor power to 45 MWt. Restarted the reactor following a scram, and obtained power coefficient measurements during approach to power.
11-30-67	At 15 MWt, the measured power coefficient approached the operating limit (0.5 Ih/MW). Reduced reactor power to 10 MWt. Rebanked the control rods and raised reactor power in 5 MWt steps. Obtained power coefficient measurements at each power level. Continued 45 MWt operation. Completed annual leak-rate test of reactor building manual pressure relief valves.
12-1-67	Placed the plugging meter on FERD system in service for operational checkout and as a means of taking plugging temperature data.
12-4-67	Placed experimental subassembly X900 containing pressure-stressed 304-L tubes in the primary-tank storage basket.
12-5-67	Primary sodium purification system shut down for repair or the P1-A loop economizer heater.
12-7-67	Performed three 50-Ih rod drops from 45 MW using a standard control rod.
12-8-67	FERD loop plugging meter being used to obtain primary sodium plugging temperature. Performed reactor drift test to determine the maximum ΔT swing. Replaced defective bearing on turbine driven condensate pump.
12-10-67	Performed a "flow reduction" test with reactor power at 41.5, 30.0, 22.5 and 15 MWt.
12-11-67	Restarted reactor for rod-drop, oscillator rod, and power-coefficient measurements. At 25 MWt, the measured power coefficient reached the operating limit of 0.5 Ih/MW. Performed an anticipatory shutdown of the reactor to 50 Kw.
12-12-67	Reactor shut down. Xenon-133 and -135 activity higher than normal in primary-tank cover gas, short-half-life fission-gas activity normal.

B. Chronology of Principal Events (continued)

DATE	EVENT
12-13-67	Completed installation and checkout economizer heater in primary plugging loop.
12-14-67	Started brush cleaning the seal troughs of the large and small rotating plugs. Completed modification of high and low steam drum level alarm on Eye-Hye indicator. Performed primary sodium flow test using primary pumps. Established flow in the plugging and sampling line of the primary sodium purification system.
12-15-67	Cold trap of primary sodium purification system returned to normal service. Removed J-2 instrument thimble to replace channel No. 3 pre-amp and cables and then replaced the thimble.
12-16-67	Completed argon purge of primary-tank cover gas to reduce the gas (xenon-135) activity level. Started biweekly and monthly interlock checks.
12-17-67	Completed brush cleaning the seal trough of the small rotating plug. Added 200 lb of alloy to the seal trough of the small rotating plug and 68 lb of alloy to the seal trough of the large rotating plug to restore normal level.
12-18-67	Completed brush cleaning the seal trough of the large rotating plug. Completed interlock and startup check sheets; took the reactor critical at 50 kW.
12-19-67	Intercalibrated all control rods at 50 kW with a 14 in. rod-bank position. Reactor shut down, Run 26C terminated with a total of 1735 MWd for Run 26. Preparations made to remove No. 6 control-rod-drive assembly because of a malfunction in the gripper jaws.
12-20-67	Replacement of No. 6 control-rod-drive assembly completed. Operational checkout of the unit satisfactory. Moved channel No. 11 from instrument thimble "01" to instrument thimble "02". Instrument thimble "01" is to be modified to provide a high-temperature test facility.
12-21-67	Started unrestricted fuel handling following the decision to terminate Run 26C and start reactor loading for Run 27. Replaced two Row-2 subassemblies.

B. Chronology of Principal Events (continued)

DATE	EVENT
12-22-67	Lost site power for a period of 68 minutes. All emergency loads carried by the 100-kW and 400-kW emergency generators. Exchanged 17 subassemblies including the installation of experimental subassemblies X029 and X033.
12-23-67	Exchanged 10 subassemblies including the relocation of experimental subassemblies X015 and X016. Detected interference at the 20 in. elevation while inserting a new control rod in the No. 9 position, core location 5B1. Rotated the control rod 180° and insertion continued normally. Installation of the next scheduled control rod proceeded normally. During removal of control rod L-446 from No. 12 position, core location 5C3, interference was encountered at the 52 in. and 69 in. elevations. The control rod was successfully removed and placed in the storage basket. The slip clutch in the drive mechanism of the core holddown upper assembly became inoperative and the force limit device apparently malfunctioned during an attempt to install a new control rod in the No. 12 position. Discontinued unrestricted fuel handling.
12-24-67	Disassembly of the holddown in progress.
12-26-67	Disassembly of the holddown completed.
12-28-67	Removed instrument thimble J-2 and replaced experimental channel No. 1 and cable. Reinstalled the thimble. The plugging loop of the secondary sodium purification system taken out of service for repair of a defective heater.
12-29-67	Repairs completed on the plugging loop of the secondary sodium purification system and the system placed in normal operation.
12-31-67	Modifications, repairs, and maintenance were in progress on the core holddown. Plans were being made to remove the control rod thimble from No. 12 position, core location 5C3, to determine the cause of the interference encountered while removing subassembly L-446.

C. Production Summary (Fiscal Year 1968)

The format for this section is changed to make it more useful in the compilation of data for other required reports.

C. Production Summary (continued)

	First Quarter	Second Quarter	Total This Year
a) Electrical MWh Generated	4721	11538	16259
b) Possible MWhe (hr. x 14.5 MWe)	32016	32016	64032
c) Plant Capacity Factor Electrical(%)	14.71	36.04	25.39
d) Thermal MWh Produced	19473	39541	59284
e) Possible MWht (hr. x 45 MWt)	99360	99360	198720
f) Plant Capacity Factor Thermal(%)	19.60	39.76	29.83
g) Reactor Critical Time (hrs)	697	1169	1866
h) Reactor Standby Time (hrs)	0	0	0
i) Reactor Availability Factor (%)	31.57	52.94	42.25
j) Time Lost due to Secondary Sodium or Steam System (hrs)	24	216	240
k) Plant Availability Factor (%)	30.48	43.16	36.82

Reduced Power and Shutdown Explanations

Full-Power Operating Days 35

Reduced-Power Operating Days

10/13 - 10/14	Power coefficient tests	2
10/15 - 10/17	Oscillator tests	3
10/18	Reduced flow tests	1
10/22	Oscillator tests	1
11/5	Reduced flow tests	1
11/6 - 11/7	Oscillator tests	2
11/18	Power coefficient tests	1
11/23	Power coefficient tests	1
11/29 - 11/30	Reduced-flow and power coefficient tests	2
12/26	Rod drop tests	1
12/9 - 12/10	Reduced-flow, rod-drop, and oscillator tests	2

C. Production Summary (continued)

Shutdown Days	Oscillator rod installation		10
	Feedwater pump repair and steam drum level instrument failure requiring Cool-down and Heat-up		9
	Loading changes		1
	Fission Gas Release and Fuel Subassembly X2111 removal		1
	Analysis of fission gas release . .	5	
	Loading changes.	5	
	Repair of Core Hold-down . . .	5	
	Investigation of control rod, and Thimble damage	5	20

D. Plant Performance

Beginning with this quarter, system performance is reported by means of graphs of various parameters made from operating instrumentation data by using computers and automatic data plotters. In most cases there has been no filtering or smoothing of the data. Therefore, some scatter in the data is due to extraneous noise or interference. All parameters are graphed with time in days as the X axis. The ordinate range is chosen by taking the normal value at 45 MW operation and including all data that extends 10% above and 10% below this value. Since it is intended that the reactor should operate at full power (45 MWt) continuously, this choice of scale will normally discard only a small amount of the data during startup and shutdown. The advantage of this expanded scale is the ability to observe trends which occur over a relatively long period of time. Deviations from normal of from 1 to 10% will be observable. During normal constant-power operation, a data scan is made every 30 minutes, and during special tests the data scans can be made at 3 or 12 minute intervals.

The only case in which more than one input signal is used for a plot is for the value of Reactor Power. In this case the value is reactor ΔT times flow times a constant. It is expected that more correlation of signals will be done in the future to simplify and improve the analysis of plant performance.

1. Power Production

The reactor was operated for a total of 1648 MWd this quarter. Operating history data are given in Tables I, II, and III. These tables are prepared from data recorded in the operations log book at the end

1. Power Production (continued)

of each day. Figures 1, 2, and 3 are graphs of the same data taking reactor on-time and generator on-time. Figures 4, 5, and 6 are graphs of cumulative thermal energy and cumulative electrical energy taken also from Tables I, II, and III. The summary of scrams from power is given in Table IV.

Figures 7, 8, and 9 are graphs of reactor inlet temperature (bulk sodium temperature), reactor outlet temperature, and reactor power. The temperatures appear to form lines at 1°F intervals. This was due to a defective circuit board in the data logger which caused the fourth digit of the four-digit number to print only odd numbers. Since the error is in the order of 0.1 to 0.5°F, it is insignificant, especially considering that no attempt is made to correct for nonlinearity in thermocouple calibration. From October 1 to November 19, the reactor inlet temperature recorded was 5° above the normal 700°F. This was due to a defective amplifier in the measuring system. The actual temperature was maintained at 700°, since the controlling temperature measurement was not affected by this defect.

Reactor outlet temperature made a step downward on October 24, while reactor power remained at 45 MWt. This was due to a defect in a component of the measurement of reactor ΔT. The reactor was actually operated at a power about 3% below the normal 45 MW for a period of time. This is confirmed by the fact that subassembly temperature rise was low by about 3% during this period. Throughout December, power level and temperature measurements were normal.

2. Primary System

a. Primary Pumps

Figures 10 through 21 are graphs of clutch current, flow, speed, and generator power for the main primary pumps. No abnormal conditions are indicated. The major variations in blanket flow are due to changes in control rod position during power coefficient experiments. Although corresponding changes in core flow do occur, they are such a small part of the total they cannot be seen very readily.

b. Primary Auxiliary Pump

The auxiliary pump ran continuously this quarter, and there was no indication of abnormal performance.

c. Coolant Temperatures

Figures 22 through 42 are graphs of subassembly outlet temperatures. The graphs indicate that the reactor was operated about 3% below 45 MW during the latter part of October and the early part of November. The greater scatter in data from some thermocouples than from others is believed

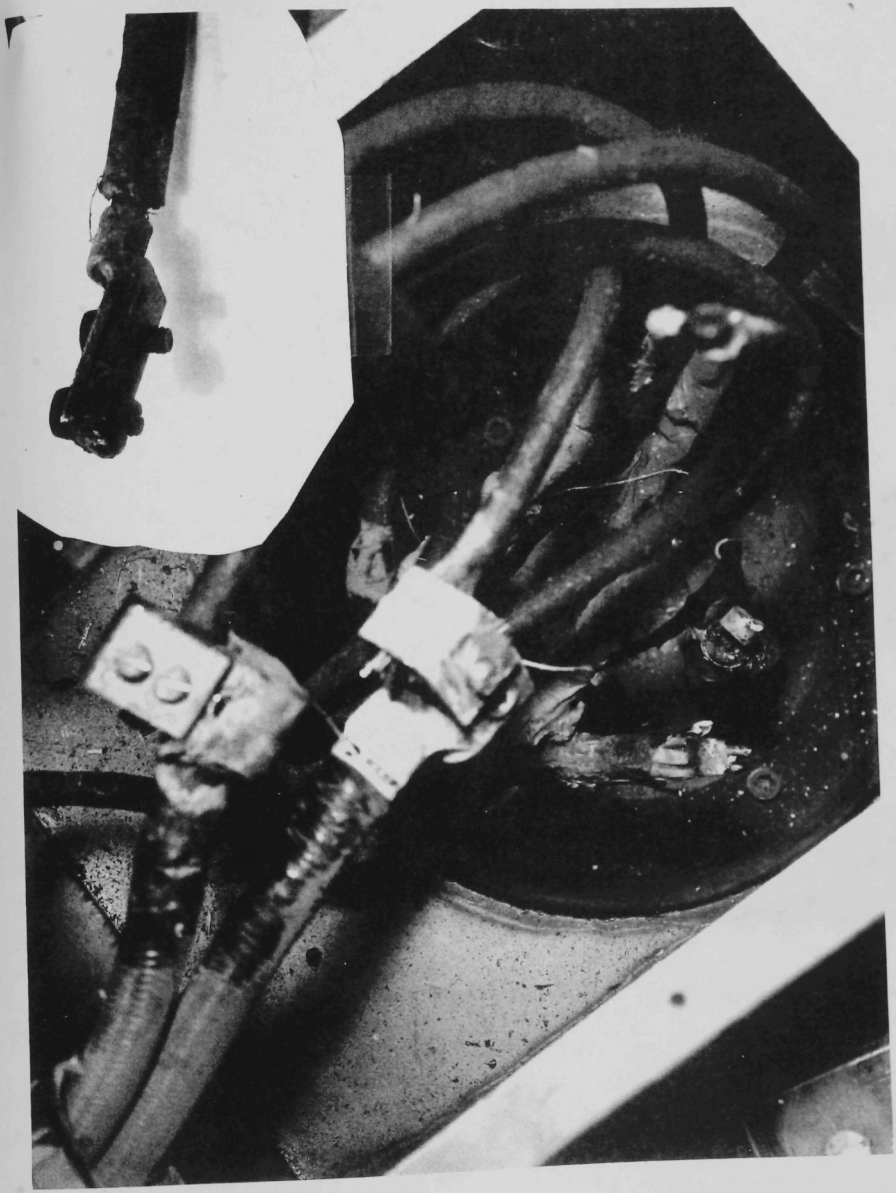

Figure 74

...c Heater Connection Failure

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